

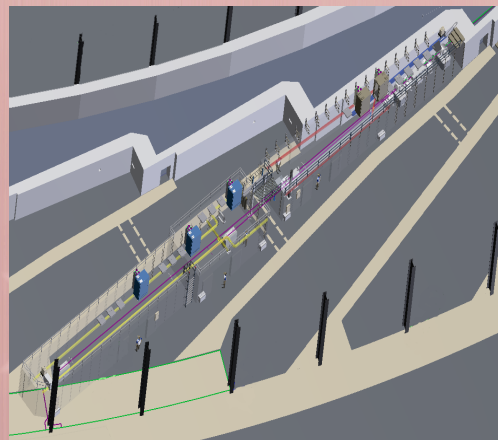
FRONTIER MICROFOCUSING MACROMOLECULAR CRYSTALLOGRAPHY BEAMLINE (FMX) BROOKHAVEN NATIONAL LABORATORY

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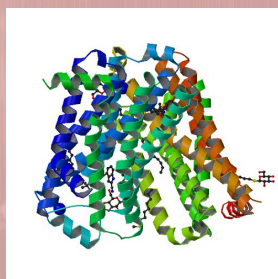
MISSION

- FMX at NSLS-II will provide structural biologists with a leading micro-focusing macromolecular crystallography (MX) beamline for the elucidation of structure and function of macromolecular complexes from small, weakly diffracting heterogeneous or especially radiation-sensitive crystals.
- Its uniquely high flux, tunable energy, variable focal spot size and beam divergence are well suited to advance studies of the most challenging bio-crystallographic problems.
- FMX, together with AMX and LIX, is funded by the NIH through the ABBIX* project for the construction of biomedical beamlines. It is part of an initial suite of three specialized MX beamlines and complements the AMX mini-beam, and the NYX high energy-resolution capabilities.

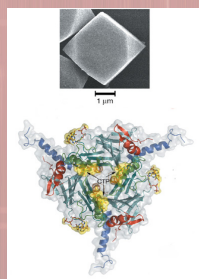
*ABBIX: Advanced Beamlines for Biological Investigations with X-rays



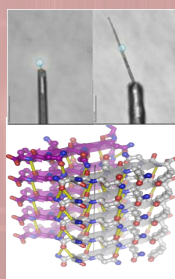
APPLICATIONS AND CAPABILITIES



From: T. Warne, M.J. Serrano-Vega, J.G. Baker, R. Moukhametzianov, P.C. Edwards, R. Henderson, A.G. Leslie, C.G. Tate, and G.F. Schertler. Structure of a β_1 -adrenergic G-protein coupled receptor. *Nature* 454, 486-491 (2008).

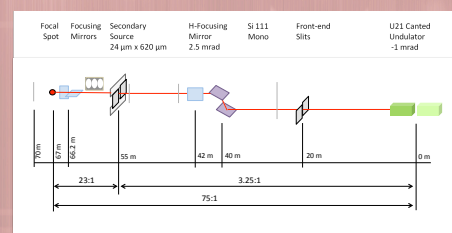


F. Coulbaly, E. Chiu, K. Ikeda, S. Gutmann, P.W. Haebel, C. Schulze-Briese. The molecular organization of cyprinid polyhedra. *Nature* 446, 97-101 (2007).



R. Nelson, M.R. Sawaya, M. Balbirnie, A.O. Madsen, C. Riekel, R. Grothe, D. Eisenberg. Structure of the cross-beta spine of amyloid-like fibrils. *Nature* 435, 773-8 (2005).

Micro crystals of the membrane protein (left), virus polyhedra (center) and amyloid fibrils (right) required micro diffraction to yield structures. With larger crystals, FMX will offer means to find best diffracting regions and mitigate the impact of radiation damage. Acoustic droplet ejection and other innovations will open a way to serial crystallography.



Source: Canted IVU21 undulator

Optics: - Double crystal mono
 - Horizontal focusing mirror
 - Secondary source aperture
 - K-B focusing mirrors

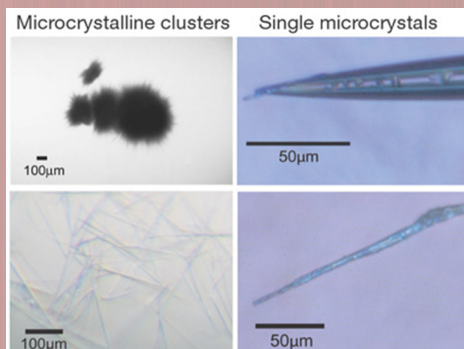
E-range: 5 – 23 keV

Flux in focal spot: $\sim 10^{13}$ ph/s

Focal spot min: $1 \times 0.8 \mu\text{m}^2$

Focal spot range: 1 – 20 μm

ADDITIONAL INFORMATION



From: M.R. Sawaya, S. Sambashivan, R. Nelson, M.I. Ivanova, S.A. Sievers, M.J. Apostol, M.J. Thompson, M. Balbirnie, J.J. Wiltzius, H.T. McFarlane, A.O. Madsen, C. Riekel, and D. Eisenberg. Atomic Structures of Amyloid Cross- β Spines Reveal Varied Steric Zippers. *Nature* 447, 453-7 (2007).

Micro-focusing at FMX will yield a beam of 1 μm diameter with an intensity exceeding by an order of magnitude that of comparable instruments elsewhere.

To fully exploit this unique capability and to expand it into the regime of the mini-beam MX beamline, FMX will feature:

- Optics to expand beam up to 20 μm with compound refractive lenses and by mirror adjustments
- Advanced fast framing pixel array detector
- Sub-micrometer precision horizontal goniometer
- Six-axis sample-changing robotic system
- Temperature control of optics and equipment to $\pm 0.1^\circ\text{C}$